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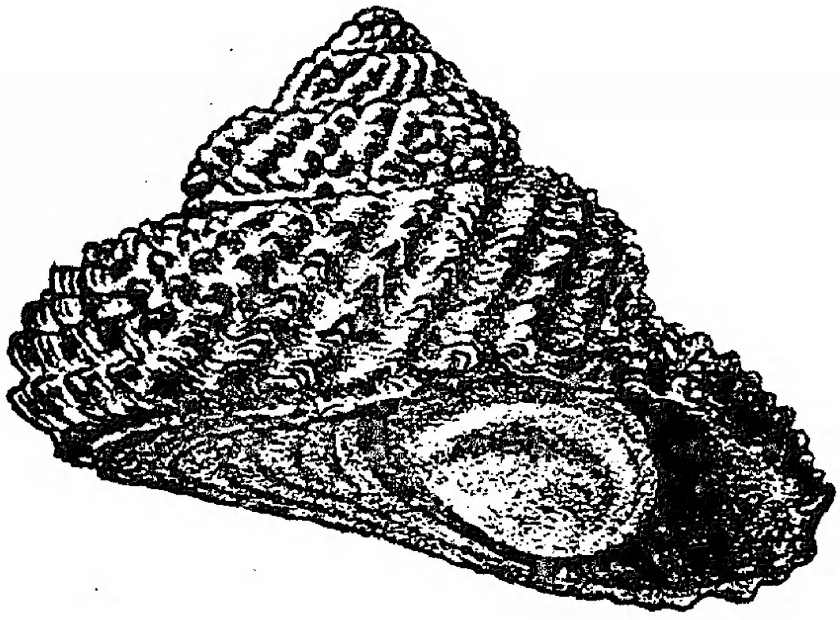

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BRACHIOPODS OF STEWART ISLAND

Summary of a talk to Wellington Shell Club -
by Joyce R. Richardson - N.Z. Oceanographic Institute

Brachiopods are rare components of existing marine faunas and Stewart Island waters have long been known to possess rich and diverse populations. Almost all the species found scattered throughout. North and South Island waters may occur together in Stewart Island, one famous dredge haul from Port Pegasus (by Acheron during the National Museum Expedition of 1971) containing five species from three brachiopod orders - living representatives are known from only four orders.

Those species collected previously from Stewart Island occupied a wide range of environments (sheltered and open, intertidal and subtidal) and contain both sessile and free lying forms. Therefore they provide the basic information from which to study correlations which may exist between physical regime and shell morphology. Since brachiopods occur in such abundance as fossils it is of value to define any structures which may be used as environmental indicators.

The National Geographic Society supported an expedition to Paterson Inlet, Stewart Island in 1977 and study of the brachiopods observed there has forced a change in many existing concepts of the Phylum. Paterson Inlet runs westward for 16 kilometres and contains a deep water area of at least 65 km^2 and brachiopods comprise the dominant fauna. Since few hard attachment sites occur on the floor of the Inlet, this dominance is the result of the presence of abundant free lying forms. Only one species, Neothyris lenticularis, is structurally modified for a free lying existence; the other three species which occur there possess the morphological characters always associated with attachment but only one of these, Notosaria nigricans, is found confined to rock faces. Terebratella inconspicua occurs as an attached form but is also common free lying on coarse substrates. Terebratella sanguinea occurs at maximum density free lying on muddy sediments and is rarely found attached. These distribution patterns for species of Terebratella differ from those observed in other New Zealand localities by Rudwick (1962), Rickwood (1965, 1977) and Doherty (1976), and Neothyris lenticularis occupies a wider range of substrates than described previously by Neall (1970,1972).

These inconsistencies in the distribution of species in Paterson Inlet and in the remainder of New Zealand are explained partly by the fact that Paterson Inlet was surveyed by SCUBA. Previous records of subtidal brachiopods are derived from dredged collections which may give misleading pictures of patterns of distribution. A further conclusion emerging from these studies is that the key to brachiopod distribution lies in the structure of the attaching organ, the pedicle. In Notosaria nigricans the pedicle is muscular, this muscularity making movement without an attachment surface as difficult as it is for a limpet without an adhesive surface. By contrast, the pedicles of Terebratella inconspicua and Terebratella sanguinea are only partly muscular, the greater components being inert, non-contractile tissues. Pedicles of this type apparently do not commit the possessor to an attached existence and are sufficiently adaptable to enable the animal to survive and function without being attached. Studies are continuing in this field so that the relationship

of the pedicle to habitat the life style may be defined. The relationship of the pedicle to its housing, the beak, is also being explored in the expectation that life style and habitat may be more readily inferred from such preservable hard parts.

List of described taxa

(For illustrations see Fig. 1)

Phylum BRACHIOPODA
Class Articulata
Family Hemithyridiae
Notosaria nigricans (Sowerby 1846)

Ordor Terebratulida
Suborder Terebratulidina
Family Terebratulidae
Liothyrella neozelanica Thomson 1918

Suborder Terebratellidina
Family Terebratellidae
Neothyris lenticularis (Deshayes 1839)
Terebratella inconspicua (Sowerby 1846)
Terebratella sanguinea (Leach 1841)

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CLASSIFICATION OF THE BIVALVIA

BY DR. A.G. BEU

The Bivalvia are not as suited to a large number of environments as are the Gastropoda, so there are nowhere near as many of them. However, as the kinds of niches they can occupy are relatively limited (burrowing, attached to substrates by byssus or cement, free-lying or boring in hard substrates), the history of the Class is one of adaptation to these niches. Accordingly, the classification is complicated by the superficial similarity of several independently evolved lines. Consequently, most of the features that have been used by early workers to draw up a classification turn out to have evolved more than once. The characters that have been used are :-

(A) The hinge

This is probably the most fundamental feature, and is still very important in classification. A number of terms have been proposed for the different types of hinge teeth. Some of the main ones are :

Taxodont ... with numerous short hinge teeth, some or all transverse to hinge margin. All teeth the same. Evolved twice in the Bivalvia.

Heterodont ... with distinctly differentiated cardinal and lateral teeth. Over half the Bivalvia including most of the "normal" burrowing types. Best developed in the Veneridae.

Schizodont ... with one tooth (median of L.V.) broad and bifid, with cross ridges. Typically in Trigonia, but modified forms are seen in the fresh-water mussels.

Edentulous ... lacking hinge teeth - either lost or never evolved.

(B) The gills, or ctenidia

The different ways in which the lobes of the gills are linked together into an efficient feeding network, a food sieve, have been used as a major basis for classification, but workers during this century have realised that different levels in this evolutionary series have been arrived at at different times by all sorts of different bivalve lineages. Gills are a useful character for recognising some minor groups such as sub-orders, etc.

(C) Musculature

A primary division can be made into :

Isomyarian ... with two adductor muscles equal in size or almost so.

Anisomyarian ... with one adductor muscle (anterior) much reduced or absent.

Dimyarian ... with two adductor muscles.

Monomyarian ... with only one adductor muscle (posterior).

Almost all standard, burrowing, heterodont bivalves are isomyarian. The anisomyarian condition reflects the fact that these are almost all the bivalves that are byssally attached to hard substrates or free-lying, or cemented to hard substrates. In other words, almost all bivalves that got away from the idea of burrowing in soft substrates (all of them except Pholadacea).

(D) Other less important features such as shell structure, mode of life and orientation, and anatomical features such as labial palps and the stomach, are used as criteria in classifications.

(Editor's note: A glossary of terms used in describing bivalves was included in "Cookia" Vol I No 2)
Readers are also referred to Dr. Beu's paper "An Outline of Bivalve Classification" in "Cookia" Vol I No I.

CLASSIFICATION

Six Sub-classes of the Bivalvia are recognised ...
Anomalodesmata
Palaeotaxodonta
Cryptodonta
Pteriomorphia
Palaeoheterodonta
Heterodonta

1. Sub-class Anomalodesmata
These are edentulous, pearly-shelled bivalves of very long time range; and probably the ancestors of all the other Bivalvia. Most are burrowers, many are deep burrowing forms living in the deep sea and thus are rarely seen by collectors. A few have adapted to the special niches of oysters (Cleidothaerus) and "Watering-pot shells" (Clavagellacea). The Sub-class was more common in Paleozoic and Mesozoic times than it is today.

Order Pholadomyoida
Superfamilies ...
Pholadomyacea
Families ... Pholadomyidae (Paleozoic-Recent), and seven extinct families.
Ceratomyacea
Families ... two extinct.
Pandoracea
Families ... Pandoridae, Cleidothaeridae, Laternulidae, Myochamidae, Periplomidae, Thraciidae, Verticordiidae.
Clavagellacea
Families ... only one, Clavagellidae, the "watering-pot shells".
Poromyacea
Family ... Poromyidae

2. Sub-class Palaeotaxodonta

Order Nuculoida
Primitive pearly shells with taxodont hinges; shallow-burrowing forms feeding by sorting the surface sediment with their extremely enlarged labial palps.

Superfamilies ...
Ctenodontacea ... an extinct paleozoic group similar to Nuculanacea but lacking a pallial sinus and a resilifer. One extinct family.

Nuculacea
Families ... Nuculidae and the extinct Praenuculidae.

Nuculanacea
Families ... Nuculanidae, Malletiidae.

The Sub-class may (?) also contain the Order Septibranchia, with one Family, Cuspidariidae. These are usually regarded as Anomalodesmata as they lack hinge teeth, but Runnegar (1974) has pointed out that they have different shell structure from Anomalodesmatans, and lack gills, and their pumping diaphragm evolved from different structures from that of the Poromyidae, the superficially similar Anomalodesmata. The shell shape and ribbing resembles that of Nuculanacea, so are they perhaps early ancestral Palaeotaxodonta that have survived because they are specialised for a very unusual niche? They lack gills, and pump very large amounts of water through the mantle cavity, and are able to sieve out and feed on much larger animals than the microplankton used by most bivalves - some utilise quite large crustaceans.

3. Sub-class Cryptodonta
These are primitive, hingeless bivalves, with largely chitinous shells. There are two orders :

Praecardioida ... extinct.
Solemyoida ... Paleozoic to living, containing only Solemya and its relatives.

4. Sub-class Pteriomorphia

This Sub-class contains the ark shells and all anisomyarian and monomyarian shells. Almost all are epifaunal, sedentary genera attached by the byssus, or cemented. Lower members have aragonite shells, but higher members include all known bivalves with calcite shells.

Order Arcoida ... ark shells and their relatives.
- Superfamilies ...
- Cyrtodontacea ... one extinct family.
- Arcacea ... byssally attached or shallow burrowing.
  - Families ... Arcidae, Parallelodontidae, Cucullaeidae, Noetidae.
- Limopsacea ... most are shallow burrowers.
  - Families ... Limopsidae, Glycymeridae, Manzanellidae, Philobryidae.

Order Mytiloida ... the mussels - anisomyarian, mostly byssally attached (some bore in rock, or nest in byssus, or burrow shallowly in sand).
- Superfamilies ...
- Mytilacea ... the true mussels
  - One Family, Mytilidae.
- Pinnacea ... the horse-mussels
  - One Family, Pinnidae

Order Pterioida
- Sub-order Pteriina ... byssally attached, inequilateral, "winged" shells.
  - Superfamilies ...
  - Pteriacea
    - Families ... Pteriidae, Isognomonidae, Pulvinitidae, Malleidae, and seven extinct families.
  - Pectinacea
    - Families ... Pectinidae, Plicatulidae, Spondylidae, Dimyidae, and eleven extinct families.
  - Anomiacea
    - One Family, Anomiidae.
  - Limacea
    - One Family, Limidae
  - Ambonychiacea
    - Four extinct families
- Sub-order Ostreina ... heavy, cemented shells, made of coarsely foliaceous calcite layers, or spongy-textured layers in some genera.
  - Superfamily ... Ostreacea - the oysters
    - Families ... Ostreidae, and related families.

5. Sub-class Palaeoheterodonta

Thia sub-class contains bivalves with pearly shells; hinge with a few radial teeth below the umbo; if lateral teeth present these are not separated off from the cardinal teeth as in the Heterodonta; teeth relatively simple and quite varied in Unionoida, but cross-ridged and complex in Trigonoida.

Order Modiomorphoida... Two Super-families and five families, all extinct.

Order Unionoida
Super-family .. . Unionacea...fresh water mussels
Families.... Unionidae, Margaritiferidae, Mutelidae, Etheridae
Two additional extinct Super-families

Order Trigonioida
Super-family .... Trigonacea... a large Mesozoic family with thick , elaborately sculptured, pearly shells, and cross-ridged teeth. There are four extinct families.
Family Trigoniidae... the only living family has only one living genus Neotrigonia of Australia

6. Sub-class Heterodonta

Over half the Bivalvia belong here. All have aragonitic shells, and live burrowed in soft sediment. The hinge has elaborately differentiated teeth, and the laterals are clearly separated off from the cardinals.

Order Hippuritoida ... a very successful Mesozic group of families of cemented shells, with one valve much larger than the other, and elaborate hinge structures. These are one of the many groups of animals such as dinosaurs, belemnites and ammonites that became extinct at the end of the Cretaceous Period.

Order Veneroida ... contains most of the 'standard' shaped shallow-burrowing bivalves, with normal heterodont hinges.
Super-families...
Babinkacea ...one extinct family
Lucinacea ...deep burrowers with a siphon at each end, and weak hinge.
Families...Lucinidae, Thyasiridae, Mactromyidae, Fimbriidae, Ungulinidae, Cyrenoididae
Chamacea.....
One family, Chamidae. Most are cemented and resemble the hippuritids in their spiral shells, but they have a relatively normal

Families ... Mactridae, Mesodesmatidae and two very minor families with one to two species each.

Solenacea ... the "razor shells", long and narrow; most with deep pallial sinuses and weak hinge at or near the anterior end.

Families ... Solenidae, Cultellidae.

Tellinacea ... moderately elongate, thin-shelled, laterally compressed burrowers; animal with two long, completely separate siphons; sinus is in the pallial line; ligament external (Tellinidae, Psammobiidae, Donacidae etc.) or internal in a pit on the hinge plate (Semelidae).

Families ... Tellinidae, Psammobiidae, Donacidae, Semelidae, Scorbiculariidae, Solecurtidae and five extinct families.

Dreissenacea ... fresh-water mussels similar in shape to true marine-mussels, but without any hinge teeth, and with aragonite, not pearly, shells of the true fresh-water mussels.

One family only, Dreissenidae.

Gaimardiacea ... a small southern ocean family of small, rounded, mussel-shaped shells, typically smooth and red (Gaimardia), but some forms are smaller, ribbed, yellow, etc; live byssally attached to floating seaweed.

One family only, Gaimardiidae.

Arctiacea ... shaped as in venerids, but almost all smooth, with less clearly defined hinge; pallial line usually entire. This is a relatively small group of northern hemisphere and tropical species, mostly fossil.

Families ... Arcticidae, Trapeziidae and seven extinct families.

Glossacea ... shells shaped and sculptured much as in Arcticacea, except beaks are spirally twisted in most. There is no pallial sinus and the hinge is slightly different from the Arcticacea and Veneracea.

Families ... Glossidae, Vesicomyidae and two extinct families.

Corbiculacea ... small venerid-like shells, hinges not as well developed as in Veneridae.

Families ... Pisidiidae - in fresh water.
Corbiculidae - in fresh and brackish water.

Veneracea ... hinge the best developed of any heterodonts, with three cardinal teeth in each valve; pallial sinus present; ovate shells; sculpture concentric or radial.

Families ... Veneridae, Petricolidae, Cooperellidae, Glauconomidae and one extinct family.

Sub-families of Veneridae ... Venerinae, Circinae, Sunnetinae, Meretricinae, Pitarinae, Samarangiinae, Dosiniinae, Cyclininae, Gemminae, Tapetinae, Clementiinae, Chioninae.

Order Myoida ... shell porcellaneous, most are thin, most species are deep-burrowers with deep pallial sinus; hinge reduced to a single cardinal in each valve or no teeth at all.

Sub-order Myina ... "normal" looking bivalves, isomyarian, with external ligament and large internal resilium.

Superfamilies ...

Myacea ... hinge teeth of most are absent; a large internal resilifer inside; pallial sinus deep.

Families ... Myidae, Corbulidae, Erodonidae and three extinct families.

Gastrochaenacea ... burrowing shells, lying free within the burrow they excavate; edentulous, widely gaping.

One family only, Gastrochaenidae.

Hiatellacea ... quadrate to irregular deep-burrowing; most with gaping shells.

One family only, Hiatellidae (contains Panopea and relatives).

Sub-order Pholadina ... shell anisomyarian, highly modified for boring in rock or wood; shell divided by an umbonal-ventral groove into differently sculptured anterior and posterior areas. Accessory shell plates are developed in most genera.

Superfamily ...

Pholadacea ... description as for sub-order.

Families ... Pholadidae - shell encloses much or all of animal; rock borers. Teredinidae - shell small, not enclosing worm-like animal, wood borers.

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GENA IMPERTUSA (BURROW 1815) IN NEW ZEALAND

By E.Y. Wolf

I wonder if Gena impertusa (Burrow 1815) will be listed in Dr Powell's new book? It is not listed in the fifth edition of his 'Shells of New Zealand'.

In 1964 I found two fresh shells washed up on Paekakariki Beach. They were very shiny, but with no animal inside. In the excitement of trying to catch them in the waves I broke one. Being a new chum, I thought they were just juvenile Haliotis; but on examining them realised they were something I had never seen before. So I took the whole one to a Shell Club meeting and asked Dr Dell what it was. "Gena impertusa, Family Stomatiidae", he said, and "Where did you get it ?". When I told him I had found it washed up at Paekakariki, he replied, "You couldn't possibly, they are not New Zealand shells".

But I did! I wish I had kept the one I had broken. Where did they come from ?

Has anyone else found any of these ?

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NOTES ON SOME AUSTRALIAN SHELLS IN NEW ZEALAND continued.

By W.J. Paul

9. HYDATINA PHYSIS ZLinne 1758

Hydatina physis is not merely an Australian shell present in New Zealand, but is one of the most widely distributed Indo-Pacific molluscs, present over large areas of the Pacific and Indian Oceans and is also present in both Australia and New Zealand.
It is present on the east coast of Africa as far south as Jeffrey's Bay, in the Cape Province. To the north it ranges as far as Japan; and eastwards it reaches Hawaii. In Australia, on the east coast it is found as far south as Sydney (or perhaps a little further), and on the west coast southwards to Cowaramup. The southern coasts and Tasmania are too cold for this type of animal.
In New Zealand it is quite a rare shell, and has been located at only a few places in the far north. It does occur at Norfolk Island and Lord Howe Island.
In a number of books (includung Cernohorsky's 'Marine Shells of the Pacific' Vol. 2) the distribution of Hydatina physis is stated to extend to Florida and the Caribbean. The shell in that area has however been identified as Hydatina vescaria Lightfoot 1786, a very similar species.

10. OFFADESMA ANGASI Crosse & Fischer 1864

Sometimes called the 'spoon-hinged shell' , Offadesma angasi is widely distributed around both main islands of New Zealand and at the Chathams. Pairs of valves are seldom collected washed up. The reason being of course that with the death of the animal the valves separate as there are no hinge teeth and no ligament. The animal lives mainly in sandy mud, and in sheltered bays along the south coast of Australia quantities are often obtained by dredging in about eight fathoms.
Originally named Periploma angasi by Crosse & Fischer, it appeared in Suter's Manual as Cochlodesma angasi.
In 1930 Iredale erected the genus Offadesma with angasi as type species.
In Australia the species occurs in southern Queensland, and round the south coast to South Australia and in Tasmania.
On a visit to Coffin Bay in South Australia, I was surprised to see a large number washed up, but only single valves.
This species is the only representative of the family Periplomidae in the south-west Pacific. A number of species of Periploma occur in the Caribbean area and on the Californian coast and about Japan.
A species very similar to Offadesma angasi is Offadesma nakamigawai Kuroda & Horikosi of Japan, which is described by Habe 'Shells of the Western Pacific in Colour Vol. 2, as "the Japanese representative of the Australian Offadesma angasi".

11. MITRA CARBONARIA Swainson 1822

Of all the shells of Trans-Tasman distribution that have been pushed back and forth from name to name by New Zealand and Australian conchologists Mitra carbonaria must be the prime example.
In New Zealand this is quite a rare shell, mainly collected in the far north. One damaged specimen was found some years ago at Karehana Bay (near Plimmerton), and this, to my knowledge, is the furtherest south it has been recorded. Live specimens are obtained only by dredging. The New Zealand shells conform to the form found on the east coast of Australia. Along the southern coast of Australia, several variants have been collected and separate names have been applied to them.
If we go back to Suter's Manual we will find the species recorded as we know it , as Mitra carbonaria. In the interim however it has been subjected to a number of name changes, and twice described as a new species.
The first change was in 1927, when Finlay redescribed it as a new species, Mitra maoria.
In 1936, Iredale described a shell in New South Wales as Vicimitra contermina ..... actually the carbonaria of Hedley's check list. This latter species was pointed out by Ponder in 1968 to be identical with maoria, and on the grounds of priority, treated contermina as a synonym of maoria. So at this stage, both the New Zealand and Australian shells were to be called maoria.
Cernohorsky had already however in 1967 (Marine Shells of the Pacific Vol 1) confounded the situation by treating both carbonaria and contermina as synonyms of Mitra nigra (Gmelin 1791) but without mentioning maoria.
This he straightened out however in 1976, in his extremely masterly treatment of the Mitridae in Indo-Pacific Mollusca Vol 3, No.17 , where he reinstated Mitra carbonaria Swainson as the correct name.
After all this it is possibly with a slight smile that one reads in Joyce Allen's 'Australian Shells' (1950) .... "For many years this went under the specific name carbonaria, but wrongly so."
In Australia there are two forms of the species .... carbonaria form and the badia form. These are virtually eastern and western forms. The former being in New South Wales and Victoria and Tasmania, while the latter is generally further west.
There is considerable variation in both size and colour, which has lead to separate names being given to a number of local variants. Synonyms are as follows:-

Of the carbonaria form.....

Mitra melaniana Lamarck 1829
" nigra Reeve 1844
" rhodia Reeve 1845
" maoria Finlay 1927
" contenmina Iredale 1936
Volutomitra digna Adams 1855

Of the badia form ....

Mitra badia Reeve 1844
" castanea Adams 1835
" rosettae Angas 1865
" perksi Verco 1908

The distribution of the species in Australia extends from southern Queensland, through New South Wales round to at least half way up the coast of Western Australia, and including Tasmania.

heterodont hinge and different shell structure in comparison to the hippuritids.

Leptonacea ... minute bivalves, some living free in sediment, many are ectoparasites on, e.g. echinoderms and other bivalves.

Families ... Erycinidae, Kelliidae, Leptonidae, Montacutidae, Galeommatidae.

Chlamydoconchacea

Family Chlamydoconchidae ..... one genus only, Chlamydoconcha, a single California species with an internal reduced shell in a slug-like animal.

Cyamiacea ... more minute bivalves that live free in sediment.

Families ... Cyamiidae, Turtoniidae, Sportellidae, Neoleptonidae.

Carditacea ... larger, strong, radially ribbed shells with well-developed heterodont hinge; usually elongate or mytiliform, some are shorter (e.g. Venericardia.) There is no palial sinus.

Families ... Carditidae, Condylocardiidae and one extinct family.

Crassatellacea ... these are similar to Carditacea but most have only comarginal sculpture or are smooth; rounded or elongate, the Crassatellidae have a truncate posterior, and an internal ligament sits in a large spoon-shaped resilifer which usually obliterates one of the cardinal teeth; most are without a pallial sinus.

Families ... Astartidae, Crassatellidae, Cardiniidae and two extinct families.

Cardiacea ... sculpture is radial, with posterior end sculptured differently from the rest of the shell; two cardinal teeth in centre and one lateral tooth at each end of a long, curved hinge plate. Most are without a pallial sinus.

Families ... Cardiidae (Cockles), Lahillidae, Lymnocardiidae.

Tridacnacea ...

One family only, Tridacnidae, the giant clams.

Mactracea ... shell thin; hinge with inverted "V" shaped cardinal in left valve, two cardinals in right valve and lateral teeth all well developed; internal resilifer for ligament; pallial line is deeply sinused; are burrowers in shallow water, mostly off sandy beaches.

PADDLING WITH HERMIT CRABS

By Mrs. E.Y. Wolf

On 29 November 1978 I did some shell collecting at Armstrong Beach, near Sarina, Queensland.
In this part of the world the tide seems to go out for miles, making it a twenty minute walk to get out to the low tide mark and the reef. While walking out across the sands we noticed small sand hillocks about two inches high and twelve inches across about half way down the beach. A hermit crab appeared from one of these. I ran the claw garden tool I was carrying across the mound and dozens of hermit crabs ran out. There must have been a shortage of homes in the crab world, as the smallest of broken shells contained a crab each. So small were they that in some cases I could hardly see the crab. The shells were mostly turrids, terebras and cancellarias; some of them really good shells. After watching and picking up the best shells I turned round, and horrors !!! There were crabs all over the place. I felt like Gulliver and the Lilliputians. The tide was going out and the water was just covering the sand. It must have been feeding time. In half an hour there was hardly a crab to be seen.
My friend, who is an ardent shell collector, and acquainted with Australian beaches, had never seen the like before. We must have just caught the tide at the right level.
Walking back over the sand flats I saw a small sprig of seaweed protruding from the sand with a shell on it. It was a live Circe trigona (Reeve). So that started me lifting all the seaweed I could see. I collected several nice shells that way.

I travelled by car from Sarina to Redcliffe, near Brisbane. We arrived at Hervey Bay just as a cyclonic storm started .... thunder, lightning, a terrific gale and very heavy rain. It was all over in ten minutes, but a lot of damage had been done at Miriamvale where we had stopped for lunch.
The next morning I was on the beach at 6.15a.m.. It was a beautiful morning and a lot of shell and other material was starting to wash up after the storm. There were lumps of soft sponge, and when I examined them found they contained live Vulsella vulsella (Linne). I have never found this species with perfect periostracum patterned by the sponge before. There were pieces of coral with live Chama attached; also beautiful small specimens of Austromactra caloundra Iredale, looking as if they had been varnished.
I wished I could have stayed on the beach for the next two or three tides.

(Editor's Note.... Vulsella vulsella (Linne) lives only in sponges.)

NOTES ON SOME SHELL COLLECTING LOCALITIES ABOUT WELLINGTON

BREAKER BAY - The Club has held one field day in this area which proved quite good. The terrain is rather rough, but exploring rock crevices can provide a number of species. Ellatrivia merces has been collected here.

CASTLEPOINT - A very profitable locality, with both sandy beach and rocky areas having interesting species. This is the only locality in the southern part of the North Island for Paratrophon strangei. Look out for Argobuccinum, Ellatrivia and Xenophalium. The mudstone platform by the lighthouse is worth checking.

EASTBOURNE - i. Muritai Beach : There is often a quantity of small shells washed up here. Glycymeris modesta seems common, and a sample of shell sand should be profiable.
ii. Small bay just beyond the gate at the end of the road: The Club held a field day here in April 1979. A list of species collected is given on Pages 18-19

KAREHANA BAY - The sandy area is poor, but the rocks at the southern end are worth visiting for limpets, Buccinulum and Zediloma. Just beyond Karehana Bay, before Hongoeka Bay, is an area of sand which is always rich in Rissoids.

LYALL BAY - Western end (on maps as Arthur's Nose) is good for shell sand. It was from this area that Miss Mestayer and Tom Iredale collected many species of small shells early this century. Benhamina and Cominella maculosa appear plentiful.

MAKARA - On the north side of the bay, past the creek mouth are extensive rock platforms yielding many small species in the tidal gutters. Caecum is common at mid-tide. Good shell sand and wash-up material is found to the south of the sandy bay. Large Cellana denticulata and Haliotis iris,

OHIRO BAY - The eastern end of the bay is good for shell sand.

POINT JERNINGHAM - Beyond Oriental Bay. Cominella striata, found in various parts of Wellington Harbour, was first observed here in 1948.

PORIRUA HARBOUR - i. Pauatahanui Inlet north end: Solemya are often washed up here and Haminoea can often be collected in qiite considerable numbers.
ii. Foreshore in front of Papakowhai: The best area in the harbour for Scutus & small species of Notoacmea.
iii. Beach behind the shops on the right just north of the bridge: If you want good clean specimens of Cominella glandiformis here is the place to look.
iv. By the causeway across Onepoto Inlet: Maoricolpus roseus can usually be found here, but they are not large specimens.
v. Small bay where Gray's Road comes over the hill: Usually a good area for Alcithoe arabica. The Club neld a field day here on one occasion and collected a lot of good shells. The list of shells collected then formed the foundation of the published list of the molluscs of the Pauatahanui Inlet in our Bulletin No.14, 1968.

PUKERUA BAY - The Club has held a field day here. The rock shelf has a fairly large typical Cook Strait fauna. Good general beach collecting.

TITAHI BAY - The bay itself is badly polluted with the sandy beach profitless. North of the beach a rough track leads down the cliff face below Terrace Road. Good spot for limpets, Notoacmea, Marinula, Neothais, Haustrum, Lepsiella, Nerita and several species of Trochidae, (Zediloma etc.).

WAIKANAE RIVER MOUTH - North side: A large sand flat is exposed at low tide, often has big wash-ups, including fossils. South side: also good for wash-ups, but mainly bivalves. Atrina is often seen here in good numbers.

WORSER BAY - The sandy areas are not particularly profitable, but good collecting from rocks. Good shell sand. Buccinulum species abound.

ISLAND BAY - The first field trip of the Club was held along the rocks at the eastern end of the bay. A large rocky shore fauna, rich in limpets, Siphonaria, Cantharidus, Littorinas . Cookia occurs below low tide. Many chitons.

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SHELL COLLECTING SOUTH OF EASTBOURNE

On 1st April 1979 the Wellington Shell Club held a field day on the beach beyond Eastbourne, and members collected in a few short hours, a total of 57 species of shells.

The shell fauna of this area had previously been recorded in the Club's Wellington Harbour faunal lists in Circular No. 12 October 1960 and revised list in Bulletin No. 29, November 1971. Species listed had been collected by members only.

In 1960 the distribution of each species collected was recorded as widespread or occurring in one or more harbour 'zones' or 'sub-zones'. In 1971 only three major zones were still considered environmentally significant. Of these the Eastbourne area lies in the 'narrows' zone stretching from Point Arthur and Point Halswell to Pencarrow and Palmer Heads. In 1960 the zone had yielded 19 species not collected elsewhere in Wellington Harbour. By 1971, further collecting around the Harbour had reduced this figure to 8 species , and of the total Harbour fauna of 356 species, 239 could occur in the Eastbourne area.

The 57 species collected in 1979 did not include minutiae, hence the comparatively short species list.

LOCALITY DATA : 1979 Eastbourne collection

The road beyond Eastbourne is blocked off by a gate where the public road ends and the private road begins. From that point on, there are several small bays, some unnamed, which have become known as Stingray Bay, Shark Bay and Half Moon Bay in that order. It is believed that some members collected as far south as Half Moon Bay and accordingly the following list of shells is presented as having been collected on the beaches between the end of the public road and Half Moon Bay, which is almost directly opposite Karaka Bay on the east side of the Miramar Peninsula.

AMPHINEURA

Ischnochiton maorianus Iredale 1914
Amaurochiton glaucus (Gray 1828)
Notoplax mariae (Webster 1908)

GASTROPODA

Haliotis iris Gmelin 1791
australis Gmelin 1791
Scutus antipodes Montfort 1810
(= breviculus Blainville 1817)
Tugali elegans Gray 1843
Cellana radians (Gmelin 1791)
denticulata (Martyn 1784)
ornata (Dillwyn 1817)
Notoacmea pileopsis (Quoy & Gaimard 1834)
parviconoidea (Suter 1907)
Melagraphia aethiops (Gmelin 1791)
Diloma arida Finlay 1927
nigerrima (Gmelin 1791)
zelandica (Quoy & Gaimard 1834)

Cantharidus opalus (Martyn 1784)
purpureus (Gmelin 1791)
Micrelenchus tenebrosus (Adams 1853)
Cantharidella tesselata (Adams 1851)
Trochus tiaratus Quoy & Gaimard 1834
Turbo smaragdus Gmelin 1791
Cookia sulcata (Gmelin 1791)
Littorina cincta (Quoy & Gaimard 1833)
unifasciata antipodum Philippi 1847
Risellopsis varia (Hutton 1873)
Struthiolaria papulosa (Martyn 1784)
vermis (Martyn 1784)
Sigapatella novaezelandiae Lesson 1831
Maoricrypta costata (Sowerby 1824)
monoxyla (Lesson 1831)
Zegalerus tenuis (Gray 1867)
Thais orbita (Gmelin 1791)
Lepsiella scobina (Quoy & Gaimard 1833)
Haustrum haustorium (Gmelin 1791)
Lepsithais lacunosus (Bruguiere 1789)
Penion sulcatus (Lamarck 1816)
Cominella maculosa (Martyn 1784)
adspersa (Bruguiere 1789)
Amalda australis (Sowerby 1830)
Siphonaria zelandica Quoy & Gaimard 1833

BIVALVIA

Barbatia novaezelandiae (Smith 1915)
Glycymeris laticostata (Quoy & Gaimard 1835)
modesta (Angas 1879)
Mytilus edulis aoteanus Powell 1958
Perna canaliculus (Gmelin 1791)
Aulacomya ater maoriana (Iredale 1915)
Pecten novaezelandiae Reeve 1853
Chlamys zelandiae (Gray 1843)
Borniola reniformis (Suter 1908)
Longimactra elongata (Quoy & Gaimard 1835)
Zearcopagia disculus (Deshayes 1855)
Gari stangeri (Gray 1843)
Tawera spissa (Deshayes 1835)
Protothaca crassicosta (Deshayes 1835)
Venerupis largillierti (Philippi 1849)
Panopea zelandica (Quoy & Gaimard 1835)

In addition several pieces of shell , obviously not of species listed, were found but were inadequate for proper identification. A couple of other items collected were : a string of nudibranch eggs of a golden colour and two pieces of a red brachiopod.

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NEW ZEALAND MACTRIDAE

By F.W. Climo in consultation with Dr. A.G. Beu

Family Mactridae Lamarck, 1809
Type genus: Mactra Linne', 1767

"Periostracum present, glossy: shell smooth or concentrically sculptured; valves slightly gaping; pallial line with sinus; siphons of animal united to their tips" (Keen, 1969:N595).

"Equivalve, slightly to strongly inequilateral Lamellibranchs with two more or less coalescent cardinal teeth in the right valve and one bifid cardinal tooth in the left valve; with two anterior and two posterior lateral teeth in the right valve, and one of each in the left valve; and with a spoon-shaped to triangular resilifer, usually situated in the centre of the hinge plate, bearing a resilium which is separate from a short dorsal ligament". (Beu, 1966, 64).

The family is divisable into five subfamilies, the type genera of each appended:

Mactrinae Lamarck, 1809 -------- Mactra Linne', 1767
Lutrariinae Adams & Adams,1856- -Lutraria Lamarck, 1799
Pteropsellinae Keen, 1969 ------ Pteropsella Vokes, 1956
Zenatiinae Dall, 1895 -------- Zenatia Gray, 1853
Resaniinae Marwick, 1931 ------ Resania Gray, 1852

Only the first and last two of these subfamilies are represented Recent in the New Zealand Region. Lutrariinine taxa do, however, extend as far as the Nukumaruan in the New Zealand Tertiary and are represented by living species in Australia.

Subfamily Mactrinae Lamarck, 1809

"Subequilateral, nearly closed; hinge well developed, two cardinals by RV somewhat joined; siphons wholly retractile within shell" (Keen, 1969: N595).

"Familial hinge characters fully developed. Shell and pallial sinus short. Hinge Mactroid or Spisuloid. Shell gaping very little. Siphons partly or wholly naked and completely retractable within the shell. Mantle lobes completely separate ventrally"

The terms 'Mactroid and'Spisuloid' - re hinge structure:

Mactroid - "ligamental surface separated from the resilifer by a ridge of shell"
Spisuloid- "which is absent in the more primitive Spisuloid type of hinge"

This hinge feature was used (e.g. Dall, 1895) to distinguish two subfamilies but later authors have pointed out that this character, although useful in taxonomy, does not split off natural groups of genera.

Genus Mactra Linne', 1767
Type species: Cardium stultorum Linne', 1758, Mediterranean

"Trigonal to oval, somewhat inflated, subequilateral; lunule and escutcheon delimited; ligament separated from resilium by shelly lamina; lateral teeth smooth; pallial sinus oval" (Keen, 1969: N595).

REMARKS: It is possible that the character of smooth lateral teeth is not a good generic distingiishing feature. I show (Climo, 1972: 99-105) that the two closely related species of Mactra s.str. in New Zealand (M.discors Gray, 1837; M. murchisoni Deshayes, 1854) are distinguished most easily on this feature. In discors the lateral teeth are smooth; in murchinsoni corrugated by transverse ridges. The shells of the two species are closely similar in all other respects that I do not believe I have two genera muddled up in Mactra, as I have applied the genus in New Zealand. However, it is remotely possible that murchinsoni could be a living representative of Spisula (Spisulona); the hinge is Mactroid in every other respect. More likely, however, this feature of striations on the lateral teeth of murchinsoni is analogous with the Mactroid versus Spisuloid hinge feature. This is a Mactroid shell with a Spisuloid striated lateral tooth.

Subgenus Mactra s. str.

"Lunule and escutcheon not set off by groove; hinge of LV with AII and 4b; RV with 3a-3b not fused above, laterals doubled; pallial sinus rounded, not deep" (Keen, 1969: N595).

REMARKS: For an explanation of the Bernard Munier-Chalmas hinge-tooth notation system used in the above diagnosis see Cox, Nuttal & Trueman (1969), and key at end of these notes.

There are two species of Mactra s. str. in New Zealand waters:

Mactra (Mactra) discors Gray, 1837
Mactra (Mactra) murchinsoni Deshayes, 1854

M. discors is fairly globose, has a dark brown periostracum, has smooth lateral teeth and prefers sheltered ocean shores (e.g. Wellington west coast beaches). M. murchinsoni is less globose, has a light strawcoloured periostracum, has ridged lateral teeth and occurs on exposed as well as sheltered ocean beaches. Both species are obtainable on Wellington west coast beaches. M. murchinsoni tends to grow larger than M. discors. See Climo (1972) for further details.

Subgenus Cyclomactra Dall, 1895
Type species: Mactra tristis Reeve, 1854 N.Z.

"Like M. (Mactroderma) but subcircular, compress, ligament, almost submerged though separate from resilium" (Keen, 1969: N597-8). The definition of subgenus Mactroderma reads: "Anterior end shorter than posterior; pallial sinus large and round" (Keen, 1969: N598).

Roughly the same size as Mactra s. str., though less triangular, thinner-shelled and a tendency to inhabit more sheltered waters.

There are two species of M. (Cyclomactra) in New Zealand.

Mactra (Cyclomactra) ovata (Gray, 1843)

Inflated, slightly triangular, yellowish exterior. Estuaries and sheltered ocean beaches.

Mactra (Cyclomactra) tristis (Reeve, 1854)

Compressed, elongated, greyish-white exterior. Heads of muddy inlets in clean estuaries (e.g. Westhaven Inlet in N.W. Nelson; Waikanae River Estuary).

Both tristis and ovata are based on Recent shells. At the moment the Pliocene-based (Castlecliffian) Mactra rudis Hutton is treated

as a synonym of tristis. M.rudis, however is, almost cicular in shape and there may be a third, Pliocene species involved. See Marwick (1948: 20-21, pl8) for discussion and illustrations.

Subgenus Longimactra Finlay, 1928
Type species: Mactra elongata Quoy & Gaimard, 1835. New Zealand.

"Long, concentric ribs stronger at ends; sinus deep, muscle scars large" (Keen, 1969: N598).
REMARKS: In shape, sculpture and colouration Mactra (Longimactra) is similar to Spisula (Oxyperas), the type S. (O.) lentiginosa (Gould 1852), probably taken from the East Indies (see Keen, 1969: N603). It is notable that special mention is made in the diagnosis of Oxyperas Moerch, 1853 of a deep sinus, as is done for Longimactra Keen's; (1969, plate E95, figs, 6a-6c) illustrations of the hinge of S. (O.) lentiginosa are not significantly different from the hinge of New Zealand Longimactra. Also, the hinge of S. (Pseudoxyperas) bernardi (Pilsbry) from Japan (Nat. Mus. N.Z. specimen no. MF 15248) is virtually identical with the hinge of New Zealand Longimactra. Pseudoxyperas Sacco, 1901 is distinguished from Oxyperas "by being less trigonal" (Keen, 1969: N604) - the hinges are the same.

Mactra (Longimactra) elongata Quoy & Gaimard, 1835

Widespread in the New Zealand region. Characteristically heavy shelled with concentric ridges, heavier at the ends, and with a variable pattern of dark brown spots or blotches on the shell. The only New Zealand mactrid with a colour pattern.

Subgenus Macrimactra Finlay, 1928
Type species: Mactra ordinaria E.A.Smith, 1898 N.Z.

"Small, outline Corbula -like, posterior end longer" (Keen, 1969z N598).

Mactra (Macrimactra) ordinaria (E.A. Smith, 1898)

Specimens in the National Museum collection from Northland to northern Nelson sandy beaches.

Genus Scalpomactra Finlay, 1928
Type species: Mactra scalpellum Reeve, 1854

"Resembling Spisula but lateral teeth not striate: resilium stout, oblique, triangular below, produced above as long spike curved to front, with minute ligament attached at top and united nearly its full length" (Keen, 1969: N601).

Scalpomactra scalpellum (Reeve, 1854)

Widespread New Zealand region, including Chatham Islands, on sandy beaches.

Genus Spisula Gray, 1837
Type species: Mactra solidum Linne', 1758

"Trigonal to ovate, not gaping, concentrically striate; lunule and escutcheon delimited; ligament and resilium not separated by shelly lamina; pallial sinus oval" (Keen, 1969: N601).

Subgenus Crassula Marwick 1948
Typespecies: Mactra aequilateralis Deshayes, 1854 New Zealand.

"Posterior area bounded by sharp ridge, sculpture only on anterior end, not wavy" (Keen, 1969: N601).

Spisula (Crassula) aequilateralis (Deshayes, 1854)

Exposed ocean beaches throughout New Zealand - characteristically blue - tinged shell; juveniles often more purple.

The taxa above, all in the Mactrinae, are adapted to one type of substatum niche. The two genera discussed below belong to other ecological niches. Beu (1966 : 63) has the following to say on this topic : "Typical Mactrid Lamellibranchs (Subfamily Mactrinae) are approximately equilateral, with short siphons and a medium-sized foot, are found all over the world burrowing to a depth of a few inches in the sand or mud of beaches and harbours. Three other subfamilies, the Lutrariinae, Resaniinae and Zenatiinae, have become adapted for other modes of life by enlargement of the foot or siphons, with consequent elongation of part of the shell".

The following key to the subfamilies of elongate mactrids is quoted from Beu (1966: 65):

1. Umbo behind the mid-point, foot very large, siphons small and completely retractable, mantle lobes separate, resilifer bent very strongly below the hinge plate.

   .... Subfamily RESANIINAE

2. Umbo in front of the mid-point, foot small, siphons large and not retractable, mantle lobes fused....

   (a) Umbo near the mid-point, foot somewhat reduced, siphons having a horny covering, resilifer in the plane of the hinge plate, no internal callus rib present, anterior muscle scars confluent.

   .... Subfamily LUTRARIINAE

   (b) Umbo very near the front, foot greatly reduced, siphons naked, resilifer bent somewhat below the hinge plate, a weak to prominent internal callus rib present, and with three separate anterior muscle scars.

   .... Subfamily ZENATIINAE

Subfamily Resaniinae Marwick, 1931
Type genus : Resania Gray, 1852

Marwick (1931: 73) introduced the subfamily without diagnosis (see discussion in Beu, 1966: 68).

Genus Resania Gray, 1852
Type species : Resania lanceolata Gray, 1852

The following shortened diagnosis is taken from Beu (1966 : 68) "Shell thin and fragile, little inflated; umbones a little behind the mid - point, very inconspicuous. Central third of valve a little thickened, with a prominent radial rib behind the anterior adductor muscle scar and a second one (occasionally bifurcating) in front of the posterior adductor muscle scar" . etc.

REMARKS: Resania and Darina Gray, 1853 from southern South America, are the only two genera in the Resaniinae, though there is some doubt that the latter is closely related to Resania,

Beu (1966: 68) points out its similarities to Anatinella Sowerby, 1833 (Anatinellidae Gray - regarded by some authors as subfamily Anatinellinae in the Mactridae) and to some members of the Mesodesmatidae.

Resania lanceolata Gray, 1852

This species is the only one , Recent, in the genus and is restricted to New Zealand. Found in both islands of New Zealand but not from the Chathams, Stewart or subantarctic islands.

Subfamily Zenatiinae Dall, 1895
Type genus: Zenatia Gray, 1853

Restricted to New Zealand and South Australia.

The following is Beu's (1966: 73) key to the genera of the Zenatiinae:

"Callus rib strong:

Umbo at anterior fifth ... Genus Zenatiopsis Tate, Oligocene-Pleistocene, Australia

Umbo at anterior third ... Genus Zenatina Gill and Darragh, Pliocene to Recent, Australia.

Callus rib very weak:

Umbo at anterior fifth ... Genus Zenatia Gray, Oligocene to Recent, New Zealand.

Posterior end roundly quadrate, shell little inflated with no dorsal area, anterior dorsal margin rounded or slightly straightened ... Subgenus Zenatia s.s.

Posterior end rounded, shell moderately inflated, with a distinct dorsal area, anterior dorsal margin straight ..... Subgenus Zenatraria new Subgenus Pliocene and Pleistocene, New Zealand".

Genus Zenatia Gray, 1853
Type species: Lutraria zelandica Gray, 1837 (=L. acinaces Quoy & Gaimard, 1835)

Subgenus Zenatia s. str.

Zenatia (Zenatia) acinaces (Quoy & Gaimard, 1835)

Throughout both main islands of New Zealand but not recorded from Stewart, Chatham or subantarctic islands.

Key to hinge notations -- in quotations from Keen (1969).

AII = anterior lateral tooth of left valve
4b = posterior cardinal tooth of left valve
3a-3b = cardinal teeth on right valve

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